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TWO PARTIALLY AMBICOLORATE FLATFISHES (HETEROSOMATA)

I.—A SUMMER FLOUNDER, *PARALICHTHYS DENTATUS*
II.—A RUSTY DAB, *LIMANDA FERRUGINEA*

BY E. W. GUDGER

INTRODUCTION

For these two abnormally colored flatfishes,[1] as well as for many other teratological fishes, the Department of Ichthyology of the American Museum is indebted to the courtesy of Mr. F. E. Firth of the U. S. Bureau of Fisheries. Stationed for duty at the Boston Fish Pier, Mr. Firth has made valuable contacts with a large circle of fishermen and has interested them in the preservation of all kinds of freak and unusual fishes. A large part of our collection of teratological fishes has come to us through this friendly coöperation.

Definite accounts of partial ambicoloration in American flatfishes are very few. In a previous paper (Gudger, 1934) I have listed these, and it is unnecessary to report these titles here. In that article I described ambicoloration in two winter flounders, *Pseudopleuronectes americanus.* One was partially ambicolorate without other deformity, the other nearly completely dark below with the rotating eye just over the dorsal crest, and with a hooked dorsal fin. Those fishes and the ones before me now have started me in extensive studies of those anomalies to which the flatfishes (Heterosomata) are peculiarly liable.

Flatfishes are teleosts which have become compressed in a right-left or lateral plane, and have come to lie on one side (the right in the summer flounder, the left in the rusty dab) which is white and blind, whereas the upper side is colored and has two eyes. Such is a normal flatfish, a teratological fish, but one which is entirely normal in its group. When a flatfish, instead of being white below, has any areas of dark color on the under side, such a specimen is called ambicolorate—with like color on both sides. More strictly a partially ambicolorate fish has a considerable area (generally solid) of dark color extending forward in varying distance from the caudal fin.

[1]These specimens were kindly identified by my colleague, Mr. J. T. Nichols.

I.—A Partially Ambicolorate Summer Flounder
Paralichthys dentatus

The specimen before me is 19.5 in. over all and 5 in. deep (body only), and weighs 13 oz. Since the average weight of flounders of this species is 3 pounds, this must be a young fish. Furthermore, fish weighing 7 to 10 pounds are not rare, and a maximum of 30 pounds and 3 feet is sometimes reached. The summer flounder is an important food fish from Massachusetts to at least as far south as Cape Hatteras.

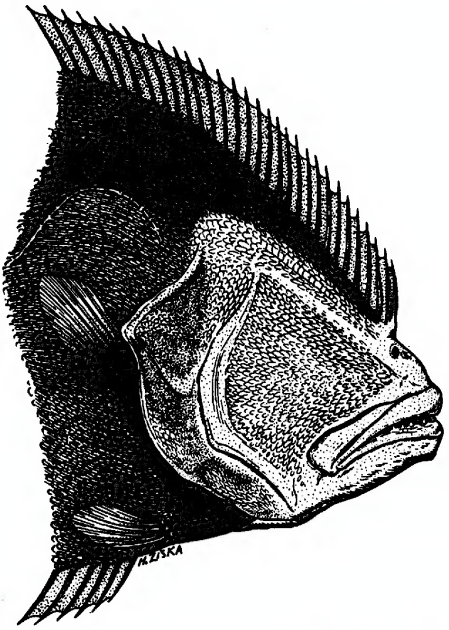

Fig. 1. Lower side of head region of a partially ambicolorate left-pointing *Paralichthys dentatus*. The whole lower side is colored like the upper, save the head as shown. The color in the opercular region is not on the outside but in the tissue lining the transparent gill covers. × ½.

The present specimen was taken in a trawlnet in water about 50 fathoms deep, southeast of Cape Henry, Virginia, by Capt. Frank Favaloro of the fishing schooner "Grace F." of Gloucester, Massachusetts, during February, 1934. He was careful to preserve and transmit it to Mr. Firth, and the American Museum profits by his interest.

The upper side of this left-handed or left-pointing flatfish is entirely normal. The coloration is normal save that the 6 or 8 brownish or dark spots have disappeared through the action of the preservative. The eyes are both on the left side, the rotating eye is clear of the dorsal crest and

there is no deformity of the anterior part of the dorsal fin. Certainly there is nothing on the upper surface either in color or structure to indicate what is to be found on the under side.

Instead of a totally white under surface one finds the situation shown in part in Figure 1. Forward from the tip of the caudal fin to the gill cover and head, the fish is as dark below as above, the dark color extending forward on the throat clear to the isthmus. The gill cover and the whole under surface of the head are white except for a narrow dark strip on the upper head at the base of the dorsal fin which extended clear to its forward extremity. On the hinder projection of the operculum there are two or three rather faint dark areas whose color is due to pigment patches not on the outside but in the tissues lining the inner surface of the operculum.

The extent of the dark area on the lower surface clear up to the head is not accompanied by and has not caused any other abnormalities. As a matter of fact the anterior section of the lateral line on the blind side is better developed and more normal than the corresponding section on the eyed side. Another difference, perceptible only after careful scrutiny, is that the scales on the white side of the head are slightly smaller than those on the dark side.

Many authors have alleged that flatfishes with considerable color below have the lower side musculature as well developed as that of the upper. To the eye, viewing the fish vertically and longitudinally to compare sides, both sides seem equally developed. But, to test the matter, in the region just above the backbone and in the same level, cuts were made down to the neural spines. The thickness of the muscles below was 9 mm., of those above, 10 mm. Thus both eye and measurement confirm the idea generally held.

II.—A Partially Ambicolorate Rusty Dab
Limanda ferruginea

This specimen was taken in a trap just outside the Gloucester, Massachusetts, breakwater on July 18, 1934, and was sent to Mr. Firth by the trap owner. It was frozen and shipped by express to the Museum, where it was received in apparently good condition, but it went to pieces badly when put into alcohol.

This dab is 17 in. long over all, and 7 in. deep (body only); it weighs 19 oz. I have been unable to ascertain the ranges in size and weight of the rusty dab, but this specimen is undoubtedly adult and presumably

of a relatively average size. *Limanda ferruginea* is a northern fish not often taken south of the Woods Hole region.

This dextral or right-pointing fish is entirely normal on the eyed or upper surface save in the anterior part of the lateral line. This branches at a point in a vertical line dividing the head in two. The forward extension runs to the hinder edge of the rotated eye. The other branch runs backward about parallel with the base of the dorsal fin for a distance of 7 scales and then turns obliquely downward a distance of 6 scales.

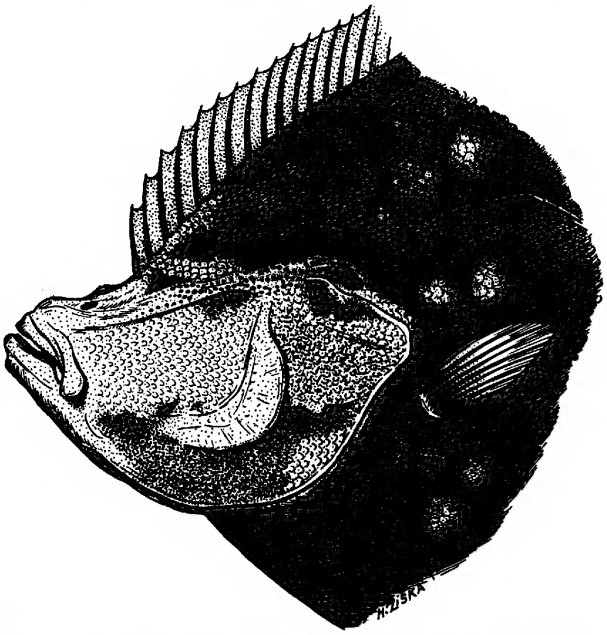

Fig. 2. Lower side of head region of a partially ambicolorate right-pointing *Limanda ferruginea*. The lower side is colored like the upper, save for some white spots on the body and the dark color on lower part of head as shown. × ½.

The lower surface is in general colored like the upper from the tip of the caudal fin clear up to the head, including the opercular region. There are, however, a number of rather small, relatively obscure, lighter colored areas scattered about. The three largest of these are in the middle part of the body and above the lateral line. Whether the scales in this region are albinistic or whether the thin colored epidermis has slipped from the scales I cannot say positively, but I am inclined to think them albinistic, since under a glass many of these white scales show numerous minute dark pigment spots.

However, our greatest interest is in the head. The subopercle is colored throughout most of its extent as Figure 2 shows. In front a little color has crept up onto the cheek. As in the summer flounder, there is color in the tissues lining the hinder part of the operculum and making this region look dark when it is really white. There is a small patch of pigment on the upper part of the opercular region. There is another patch on the head forward of the last, and still another under the anterior base of the dorsal fin. There is also faint pigmentation under the hinder end of the maxillary. On the upper part of the gill cover and on the corresponding parts of the shoulder region and the head as far forward as the anterior dorsal spine, the scales are reduced in size and are markedly spinose. This region is very rough to the finger. All these characters are shown in Figure 2.

This is the first dab that I have ever seen, and when the specimen was unpacked I was led to think that there was before me a case of head anomalies. This conclusion was based on the large amount of pigmentation on the under side of the head, on the concave forehead, and on the very high position (dorsally speaking) of the rotated eye. But Mr. Nichols looked up a figure of a normal *Limanda ferruginea* and showed me that the deeply concave forehead and the highly placed left eye are normal characters of this species.

The absence of head anomalies, even though there is present a very large amount of pigmentation on the lower surface of the fish, is correlated with the fact that the head coloration is practically confined to the gill cover. In this respect, this fish agrees with what has been found in an extensive study (to be published later) of all the known records of partially ambicolorate flatfishes. Furthermore there is further correlation with the presence of white patches (the three largest of which are about the size of a finger nail) scattered over the dark under surface. There are two cases in the literature of European flatfishes with lower side coloration almost parallel to this one. These will all be considered later in a general study of partial or incomplete ambicoloration which is in progress.

To the eye the blind side musculature of *L. ferruginea* does not seem as well developed as that of the upper side,—the lower side looked flat or even slightly concave. Dissection and measurements give the thickness down to the neural spines as 7 mm. below and 9 mm. above. However, it must be remembered that this fish had been frozen for shipment and it is quite possible that this may have affected not merely the appearance but the actual thickness after being thawed and put in al-

cohol. At any rate one cannot be so sure of the condition in this fish as in the much better preserved *Paralichthys dentatus*.

There are in the literature two other records of flatfishes with a considerable amount of color on the lower head parts but with a good deal of white scattered throughout the lower dark area. The balance of light and dark areas has in all cases seemingly prevented the formation of any head anomalies. One of these fishes is Hussakof's *P. dentatus* shown in Figure 3. These cases will all be considered in the general paper referred to.

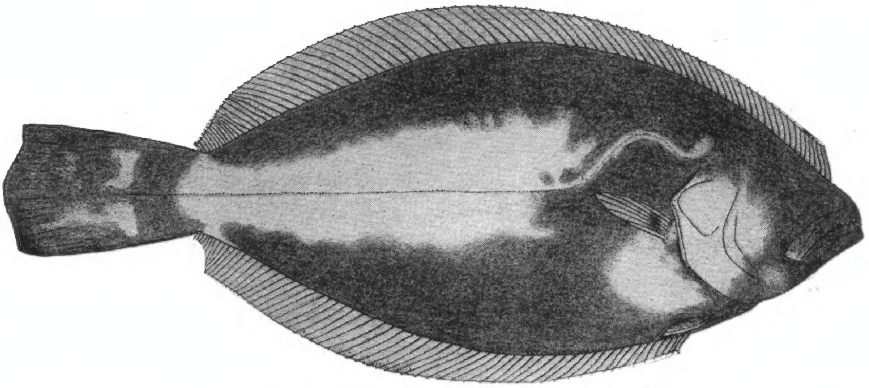

Fig. 3. Under side of a partially ambicolorate *Paralichthys dentatus*. This is the most unusually colored flatfish ever figured. The large amount of dark color on the head seems to be balanced by the large areas of white on head and body, and hence other head anomalies are absent. After Hussakof, 1914.

If the lateral line on the upper surface, as described above, is at all normal, that below is certainly abnormal. In a vertical of the hinder third of the operculum, it dips down to this and abruptly ceases where opercle and head become confluent.

General Notes

I have been at work for a year and a half on the problem of abnormal coloration of flatfishes. The data are enormous and chaotic. That for reversal has been worked up, and study is in progress on that for partial ambicoloration. From the work on the latter subject a few brief notes will be added pertaining to my specimens. Such data for American flatfishes are few.

Paralichthys dentatus.—The summer flounder seems more given to partial ambicoloration than most American flatfishes. In addition to the specimen described herein, Hussakof (1914) has described two partially ambicolorate fish from Cape Lookout. One of these had the hinder half

of the body dark-colored plus a dark peninsula projecting forward on the ventral surface clear up to the throat. The other was such an unusually colored specimen that Hussakof's figure is introduced here as my Figure 3 in place of a description. Here, as in my dab, the large amount of dark on the head is balanced by the larger areas of white on head and body, and eye and dorsal fin anomalies are absent. These fish are the only partially ambicolorate specimens of *P. dentatus* heretofore on record.

However, after the above was written, Mr. John C. Pearson, of the U. S. Bureau of Fisheries, wrote me that some years ago he examined two ambicolorate specimens of *Paralichthys dentatus* "from the catch of a winter trawler off the Virginia or North Carolina coast." The first, an incompletely ambicolorate fish, had the dark color covering approximately the hinder half of the lower surface, the forward section being white. As is to be expected, there was neither eye nor dorsal fin abnormality. The second specimen was completely ambicolorate save for a small white patch in the region of the gill cover. As is always found in cases of extreme ambicoloration, the dorsal fin was strongly hooked, and the right or rotating eye was arrested when it had got barely over the dorsal crest. These conditions closely parallel what I have previously described in a nearly completely ambicolorate *Pseudopleuronectes americanus* (Gudger, 1934).

These specimens belong to the collections of the U. S. Bureau of Fisheries, but when the Bureau moved to the new Department of Commerce Building, they were misplaced and at present are not available for study. I greatly regret that I am unable to give a detailed description of the second fish. But Mr. Pearson's letter enables me correctly to add this fish to the category of practically completely ambicolorate flatfishes with eye and dorsal fin anomalies.

It is significant that five ambicolorate flounders of the same species (*P. dentatus*) have been captured in the same general region—Hussakof's two from off Cape Lookout, my one fish from off Cape Henry, and Mr. Pearson's two from off the Virginia-Carolina coast. It would be of very great interest to examine large catches of this flounder from this general region, to ascertain if the abnormal fish occur sporadically or if they are found in any considerable numbers. No explanation for this seeming prevalence can be offered.

Limanda ferruginea.—The rusty dab, so far as I know, has never before been found in our waters with any degree of ambicoloration. This abnormality has been much described in European flatfishes, and among

these, eleven cases have been found on record for the European dab, *Limanda limanda.* Since these European specimens will be described in the general paper referred to, it is not necessary to refer to them further here.

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